IE PATENT APPLICATION No. 930995

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ABSTRACT

"Animal Feedstuff Production"

(Fig. 1)

A production system is disclosed for production of animal feedstuffs. There is a raw material bin (5) associated with each raw material and a controller sequentially controls delivery of each raw material onto a weighing platform (7) until the total composition and weight for a single 2-tonne batch unit has been delivered. Production is controlled in batch units although an overall batch run may comprises 20 to 30 tonnes in total. After grinding and mixing, a buffer bin (19) holds a batch unit and interactive control may be used for controlling delivery of a batch unit to subsequent production stages. A meal molasses mixer (20) provides a final stage for meal which may then be directly packed. There are three cuber lines, one of which has an expander (39) and an enzyme-addition station (47). The cuber lines are connected in such a way that there is a large amount of versatility because a wide range of different feedstuffs may be produced by the one overall production system.

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APPLICATION No. 930995

"Animal Feedstuff Production"

The invention relates to the production of animal feedstuff.

Quality control in animal feedstuff production is of vital importance. The primary reason for this is that if quality control procedures are not adhered to, there is a possibility that not only would the feedstuff produced not have the correct food quality for the animals, but more importantly, it could also cause disease. For example, it is believed that the disease salmonella in poultry may be caused by low-quality feedstuffs. It is of course also extremely important that the production efficiency be very high, both in terms of throughput of the production system and also in terms of utilisation of raw materials. Some raw materials can be extremely expensive and it is essential that they are utilised to the full.

In view of these requirements, it has been the tendency to build a production system which is dedicated to production of a particular type of animal feed. Such a production system comprises items of equipment such as that described in European Patent Specification No. EP-B-0,331,207 (Amandus Kahl). In this specification, a machine is described for conditioning of animal feed concentrate before discharging to a pelleting press. The conditioning machine comprises a compression chamber which allows for the injection of liquids and steam. As the material moves through the chamber temperature and pressure increases as a result of frictional conditioning within the chamber. At the end of the chamber the material is forced through a ceramic cone head thus giving a flash temperature at this point. Such equipment is extremely effective, but it is also expensive and it is essential that utilisation of such equipment is optimised. Accordingly, it has

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generally been the practice to install such an item of equipment in a dedicated production system for production of a single range of related types of animal feedstuffs such as broiler and turkey pellets.

The invention is directed towards providing a production system which is capable of producing a very wide range of animal feedstuffs in a high-quality and efficient manner.

According to the invention, there is provided a production system for animal feedstuffs, the system comprising :

a set of input bins for reception of delivered raw materials;

a conveyor system for conveying the raw materials from the input bin to a set of material bins;

a weighing platform mounted beneath the raw material bins;

a weighing controller connected to a conveyor system to control delivery of raw materials directly to a pre-set raw material bin associated with each particular raw material, the weighing controller being connected to outlet valves of the raw material bins and to load sensors of the weighing platform, the weighing controller comprising means for sequentially opening each valve for appropriate raw material delivery onto the weighing platform in succession, each valve being open until the load sensors detect a pre-set incremental weight on the weighing

platform, the total weight being that of a single batch unit;

a conveying system for conveying feedstuff from the weighing platform to a feeder for delivery of feedstuff into a grinder;

a hopper mounted beyond the outlet of the grinder for addition of low-quantity raw materials;

a conveying system for conveying the feedstuff from the grinder and the additive hopper to a primary sieve having means for removal of coarse particles;

a holding bin for reception of the output of the primary sieve;

a mixer fed from the holding bin for mixing of the raw materials and addition of some oil-based raw materials;

a buffer bin having a capacity for storage of a batch unit in the range of 1.5 to 4 tonnes of feedstuff mounted for reception of the output of the mixer;

an automated controller connected to the weigh controller and to the feeder, grinder, sieve, holding bin and mixer and having means for operating the devices for automatic processing of a batch unit and of subsequent batch units being in preceding devices to provide a total batch run;

a meal molasses mixer at the outlet of the buffer bin and being connected to a conveying system to final production devices;

a pellet cuber line connected for reception of feedstuff from the buffer bin and comprising;

a conditioner having means for agitating the feedstuff and injecting steam to bring the feedstuff to a temperature in the range of 40 to 50°C;

an expander for reception of the output of the conditioner, the expander having means for cooking the feed by steam injection and by friction to bring the feedstuff to a temperature in the range of 110°C to 120°C for a time period in the range of 20 to 30 seconds;

a pellet mill connected after the expander for production of feedstuff pellets;

a fan-driven cooler for cooling the pellets;

a switch valve connected at the output of the cooler to allow delivery of pellets to a crumb machine;

a sieve for the pellets, the outlet of the sieve having a re-cycling line for fines and a direct output line;

an enzyme-addition station in the direct output line, the enzyme-addition station

having a reservoir hopper mounted over a mixer conveyor for delivery of a consistent feed quantity, the station further comprising a nozzle for spraying at a consistent rate enzymes into the feedstuff while it is being conveyed,

a packing plant connected both to the meal and molasses mixer and to the cuber line; and

a bulk handling station.

In one embodiment, the system further comprises at least one additional cuber line comprising :-

a loading bin for reception of feedstuff from the buffer bin;

a conditioner having means for injection of steam for heating of the feedstuff;

a pellet mill for pelletising the conditioner into nuts having a diameter in excess of 5 mm;

a fan-driven cooler;

a crumb device and a switch valve for direction of feedstuff to the crumb device; and

a sieve having a re-cycling output line and a direct output line.

Ideally, the controller comprises means for receiving interactive user inputs at a control panel for processing of the feedstuffs beyond the buffer bin.

In another embodiment, there is a live bin mounted between the weighing platform and the feeder for the grinder, the live bin having means for preliminary mixing of the raw materials, and preferably there is a pair of live bins mounted in parallel, and preferably there is a pair of grinders mounted in parallel.

Ideally, there is a magnetic metal detector mounted at the inlet of the grinder.

In one embodiment, the primary sieve comprises a brushing arrangement in which brushes are mounted centrally on a rotating shaft in the housing.

In another embodiment, the cuber line has an initial loading bin for reception of feedstuff from the buffer bin.

In a further embodiment, there is an auger feeder mounted between the loading bin and the conditioner.

Ideally, steam is injected into the conditioner of the cuber line at a pressure in the range of 3.5 to 4.5 bar.

In a still further embodiment, the conditioner of the cuber line comprises means for input of molasses to the feedstuff.

Ideally, the system comprises means for injecting steam at a pressure in the range of 6.5 to 7.5 bar into the expander of the cuber line.

Preferably, means are provided for maintaining a pressure of 2 to 4 bar in the cone of the expander.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings, in which :-

Fig. 1 is a diagrammatic view showing the initial part of a production system of the invention, in which the primary components are weighing and grinding equipment;

Fig. 2 is a diagrammatic view showing a further portion of the plant, this portion being for pelletising the product;

Fig. 3 is a diagrammatic view showing the output stages of the production system; and

Fig. 4 is a diagrammatic view showing an enzyme additive station in more detail.

Referring to the drawings, there is shown a production system for the production of a wide variety of animal feedstuffs. Examples of the feedstuffs produced are dairy, beef, pig or horse nuts (6 mm), broiler or turkey pellets (3 mm) or alternatively sheep feedstuff nuts. In addition, meal and crumb may be produced, depending on the particular customer requirements. The production system of the invention is constructed to provide for the production of a wide variety of feedstuffs in all of the required physical forms such as pellets, nuts, meal and crumb.

As shown in Fig. 1, the production system comprises an input bin 1 into which raw material is delivered. An

elevator 2 conveys raw materials from the bin 1 upwardly into a conveyor system 3 for delivery of the raw material to a particular one of a set of raw material bins 5. Each raw material bins 5 is pre-set for storage of a particular raw material and this is not changed without re-setting of parameters in the various controllers of the system. There is an outlet valve 6 for each bin 5 and mounted directly beneath the valves 6 there is a weighing platform 7. A weigh controller, not shown, is connected to the outlet valves 6 of the raw material bins 5 and to load sensors of the weigh platform 7. The weigh controller is constructed to sequentially open each valve 6 for delivery of each appropriate raw material for a particular batch in succession onto the weigh platform 7. Each valve is opened until the weighing platform load or weight sensor detects a pre-set incremental weight on the platform 7. Thus, the total batch unit weight builds up by sequential dumping of each additional raw material onto the platform 7 and there is no need to weigh each portion separately in a separate device. This is very important for efficiency. Another important aspect is the fact that individual batch units are weighed to initiate production of a single batch unit of animal feedstuff. An automated controller which primarily controls the parts of the system shown in Fig. 1 directs processing of a single batch unit with further batch units following immediately behind. Thus, a total batch run of, say 30 tonnes is produced in fifteen separate batch units, each of 2 tonnes. Each batch unit may be handled efficiently and more importantly, quality may be more readily controlled by processing in this manner.

A conveyor 8 and an elevator 9 convey the weighed batch unit raw materials to a pair of live bins 11 having inlet valves 10. The live bins 11 are constructed to carry out some grinder preparation work by breaking down and

improving the mix of raw materials. The use of two bins in parallel allows the holding of two batch units at the same time at this stage in the production process.

Feeders 12 deliver the raw materials into a pair of parallel grinders 13. Magnets 13A are mounted at the inlet of each grinder 13 for detection and removal of items of steel which may become mixed with the raw materials. Each grinder 13 comprises a steel mesh and an auger system constructed to force the mix through the mesh. The detectors 13A help to remove foreign matter which could damage the meshes of the grinders 13 and this helps to avoid downtime.

Raw materials to be added in small quantities such as vitamins which may be added in quantities as low as 2.5 kg per 2 tonne batch are added in manually-loaded hoppers 14 at the outlet of the grinders 13. It has been found that by adding low-quantity additives at this stage, better mixing and dispersion throughout the batch is achieved. This is an important aspect as it helps to ensure that each unit of packed animal feed which is sold includes the correct proportion.

Another important aspect is the fact that the ground feedstuff is conveyed to a primary sieve 16 by an elevator 15. The sieve 16 is for removal of coarse particles and comprises brushes mounted centrally on a rotating shaft in a cylindrical housing. This improves the mixing and provides for effective dispersion of the additives and also helps to avoid any problems which may be caused by one or other of the grinders 13 not operating effectively. For example, if part of the mesh or screen of a grinder 13 became damaged, large particles could pass through and these are broken down by the primary sieve 16.

The output of the primary sieve 16 is delivered to a holding bin 17, which in turn is constructed to deliver the material into a mixer 18. The mixer 18 has a blender and an inlet for oil-based raw materials such as tallow. It has been found that oil-based raw materials such as tallow may be effectively admixed at this stage, after the grinding. Indeed, some such raw materials could prevent effective operation of a grinder by in effect clogging the mesh or screen of the grinder.

The system then comprises a buffer bin 19 to take the output of the mixer 18. The buffer bin 19 has a capacity for a single batch unit of 2 tonnes of animal feedstuffs.

The automated controller mentioned above operates to control the processing of a single batch unit from the raw material bins 5 to the buffer bin 19. This process is almost totally automatic with only minor portions being either interactive or manual, such as the addition of additives via the hoppers 14. This automatic, sequencing operation of the controller helps to provide efficiency as batch units may trail each other by only a single device. Thus, there may be one batch unit in the buffer bin 90, another in the mixer 18, another in the holding bin 17, another in the sieve 16 and so on. Thus, quite a large batch run of up to 30 tonnes of feedstuff may be processed quite efficiently, while at the same time achieving the advantages of individual control of small amounts of 2 tonnes. An important aspect of this system is the buffer bin 19 which is effectively the dividing line between a highly automated part of the system and the remainder of the system which provides several different routes for the feedstuff, the routing being controlled in an automatic and interactive manner via a control panel. The buffer bin 19 provides the starting point for this part of the production processes.

Where the end product is meal, valves of the outlet of the buffer bin 19 are controlled for delivery of the feedstuffs through a molasses mixer 20 for addition of molasses. The outlet of the molasses mixer 20 is connected directly to a packing station, described below.

However, where the end product is nuts or pellets, the feedstuff is directed to one of three cuber lines, shown in detail in Fig. 2. As shown in Fig. 2, there is a number of conveyors 31 to 35 inclusive. The conveyors 31 and 32 are for delivery of meal directly to bulk bins and to a packing station, respectively. The conveyors 33,34 and 35 are for delivery of the feedstuff to the cuber lines identified as cuber 3, cuber 2, and cuber 1 respectively. The line cuber 1 is now described in detail. This line is for production of 3 mm pellets, particularly for broiler and turkey feed, but also for weaners, pigs, sows, calves and lambs. The raw materials for such feed vary depending on the particular customer requirements but would generally comprise materials such as fish meal, wheat, barley, soya, and tallow. The line cuber 1 comprises a loading bin 36 into which the feedstuff is delivered from the buffer bin 19. An auger feeder 37 delivers the feedstuff to a conditioner 38. The conditioner 38 is connected to a boiler, not shown, for reception of steam at 4 bar. This conditioning brings the feed to a temperature in the range of 40 to 50°C. Molasses may be added to the feedstuff at this stage.

The conditioner 38 delivers the feed to an expander 39.

The purpose of the expander 39 is to improve digestibility of the feedstuff, for example, to improve the lactic acid production in the gastrointestinal tract of weaners. Improvement of lactic acid production leads to reduced

diarrhoea, higher feed consumption and better feed utilisation. For broiler feedstuffs, operation of the expander 39 may increase the percentage of metabolisation by 2-5%, depending on the raw materials. The expander 39 comprises a thick-walled mixing tube housing a worm shaft. There is an adjustable cone at the outlet to form an annular gap. Steam is injected into the expander at a pressure of 7 bar, this alone being capable of bringing the feedstuff to a temperature of 90°C. However, there is additionally a very large amount of friction in the expander and this friction together with the high pressures is sufficient to bring the feedstuff to a temperature of approximately 116°C and generally in the range of 120-130°C. These high temperatures are achieved for approximately 20 to 25 seconds, this being the length of time the feedstuff takes to pass through the expander to the annular gap. The pressure applied by the expander cone ranges between 2 and 6 bar, depending for example on the level of tallow and fat generally in the feedstuff. At the outlet, beyond the annular gap, the pressure of the feedstuff drops spontaneously, and the feedstuff expands and there is some flash evaporation. The flash evaporation leads to some drying. The next station is a pellet mill 40. The pellet mill is of conventional construction and produces 3 mm pellets which are delivered into a cooler 41. The cooler 41 comprises a cooling bin and a fan 43 which draws air upwardly through the batch of pellets to cool them. The cooled pellets may then be fed to a crumb machine 44 which comprises a pair of adjacent rollers for crumbling the pellets so that the feedstuff is free-flowing. The crumb and/or pellets may then be fed through a sieve 45 which outputs fines on an output duct 46 for re-circulation through the cuber line. A direct output line of the sieve 45 leads to an enzyme addition station 47 which is described in more detail in Fig. 4.

The station 47 is fed by a conveyor belt 80 from the sieve 45 and this delivers the feedstuff into a reservoir hopper 80 having a level detector 82. Approximately 500 kg of feedstuff is maintained continuously in this hopper 81. There is a slow-moving conveying auger 83 mounted in a housing 84. In addition, there is a nozzle 85 for spraying of liquid enzymes delivered from tanks 86. The outlet of the housing 84 delivers the feedstuff to a conveyor 87 which delivers it to a packing station. The auger 83 provides a tumbling action which helps to mix in the sprayed enzyme while conveying the feedstuff along the housing 84. It has been found that by applying the enzyme in this manner, the dosing rate may be controlled to close tolerances. Control of the dosing rate is particularly important because of the small quantities of enzyme involved. For example, there may be only 0.7 litres per tonne of feedstuff. It is important that a constant pressure is maintained at the nozzles 85 and an accurate flowmeter is used to monitor throughput. An enzyme controller connected to the various devices ensures that an alarm signal is generated if the flow rates deviate outside the pre-set tolerance ranges.

The production line "cuber 2" has a loading bin 50, an auger feeder 51, a conditioner 52, a pellet mill 53, a cooler 54, a crumb machine 57 and a sieve 58. Thus, it has all of the components of cuber 1 with the exception of an expander and an enzyme addition station. The pellet mill 53 is constructed differently from the pellet mill 40 and is for production of larger granules, in this embodiment 6 mm nuts, primarily for pig feed. In addition, however, the line cuber 2 can produce feed for weaners, calves, lambs, and also dairy and beef feed. The cooler 54 comprises a cooling bin 55 and a fan 56 for drawing of air upwardly through the feed. In this line, the only steam injection is at the conditioner 52 and this

is at a pressure of 3 to 4 bar to heat the feedstuff to 65 - 85°C. There is generally a small additional increase in feedstuff temperature in the pellet mill 53 caused by friction of the plates and this may increase the temperature by 7 - 10°C. Molasses are generally added at the conditioner 52 and depending on the nature of feedstuff being produced they may be added at the rate of 80 to 150 kg per 2 tonne batch unit.

The conveyor 33 leads to a third cuber line namely cuber 3, in which parts similar to those described with reference to the line cuber 2 are identified by the same reference numerals. Indeed, the line cuber 3 is quite similar to cuber 2 and is simply used to provide for additional production capacity by way of parallel production. In practice, different types of feedstuff are directed through one or other of the cuber lines, depending on the nature of the feedstuff and the potential problems which could be caused by particularly sensitive batches following batches which may affect them.

As shown in Fig. 3, the conveyors 32 and 31 lead to a packing station 60 and to a bulk handling station 70. The packing station 60 comprises a pair of packing bins 62 and 63 mounted in parallel and these are mounted to deliver feedstuff to a bagging plant 64. The bulk handling station 70 comprises a set of bins 71, each for storage of a pre-set type of animal feed and is mounted for delivery of the feedstuff directly a lorry driven in underneath.

Control of the production system from the buffer bin 19 onwards is carried out in a semi-automatic manner. Human intervention is required for making decisions in many instances such as the manner in which the feedstuff is routed to the various cuber lines and packing stations. The system has been constructed to allow for maximum

versatility and production of a wide range of different types of animal feedstuffs by use of the primarily automatic portion of the system shown in Fig. 1 and by routing of the feedstuffs from the buffer bin 19 to various other portions of the system. Further, the manner in which batch runs are handled in relatively small, 2 - tonne batch units provides for good control of production, particularly when low-quantity raw materials are being added such as enzymes and vitamins. It will be appreciated that the various portions of the system have been interconnected in such a way as to provide the efficiency, versatility and quality control which is desirable.

The invention is not limited to the embodiments hereinbefore described, but may be varied in construction and detail.

CLAIMS

1. A production system for animal feedstuffs, the system comprising :

a set of input bins for reception of delivered raw materials;

a conveyor system for conveying the raw materials from the input bin to a set of material bins;

a weighing platform mounted beneath the raw material bins;

a weighing controller connected to a conveyor system to control delivery of raw materials directly to a pre-set raw material bin associated with each particular raw material, the weighing controller being connected to outlet valves of the raw material bins and to load sensors of the weighing platform, the weighing controller comprising means for sequentially opening each valve for appropriate raw material delivery onto the weighing platform in succession, each valve being open until the load sensors detect a pre-set incremental weight on the weighing platform, the total weight being that of a single batch unit;

a conveying system for conveying feedstuff from the weighing platform to a feeder for delivery of feedstuff into a grinder;

a hopper mounted beyond the outlet of the grinder for addition of low-quantity raw materials;

a conveying system for conveying the feedstuff from the grinder and the additive hopper to a primary sieve having means for removal of coarse particles;

a holding bin for reception of the output of the primary sieve;

a mixer fed from the holding bin for mixing of the raw materials and addition of some oil-based raw materials;

a buffer bin having a capacity for storage of a batch unit in the range of 1.5 to 4 tonnes of feedstuff mounted for reception of the output of the mixer;

an automated controller connected to the weigh controller and to the feeder, grinder, sieve, holding bin and mixer and having means for operating the devices for automatic processing of a batch unit and of subsequent batch units being in preceding devices to provide a total batch run;

a meal molasses mixer at the outlet of the buffer bin and being connected to a conveying system to final production devices;

a pellet cuber line connected for reception of feedstuff from the buffer bin and comprising;

a conditioner having means for agitating the feedstuff and injecting steam to bring the feedstuff to a temperature in the range of 40 to 50°C;

an expander for reception of the output of the conditioner, the expander having means for cooking the feed by steam injection and by friction to bring the feedstuff to a temperature in the range of 110°C to 120°C for a time period in the range of 20 to 30 seconds;

a pellet mill connected after the expander for production of feedstuff pellets;

a fan-driven cooler for cooling the pellets;

a switch valve connected at the output of the cooler to allow delivery of pellets to a crumb machine;

a sieve for the pellets, the outlet of the sieve having a re-cycling line for fines and a direct output line;

an enzyme-addition station in the direct output line, the enzyme-addition station having a reservoir hopper mounted over a mixer conveyor for delivery of a consistent feed quantity, the station further comprising a nozzle for spraying at a consistent rate enzymes into the feedstuff while it is being conveyed,

a packing plant connected both to the meal and molasses mixer and to the cuber line; and

a bulk handling station.

2. A system as claimed in claim 1 further comprising at least one additional cuber line comprising :-

a loading bin for reception of feedstuff from the buffer bin;

a conditioner having means for injection of steam for heating of the feedstuff;

a pellet mill for pelletising the conditioner into nuts having a diameter in excess of 5 mm;

a fan-driven cooler;

a crumb device and a switch valve for direction of feedstuff to the crumb device; and

a sieve having a re-cycling output line and a direct output line.

3. A system as claimed in claim 2, wherein the controller comprises means for receiving interactive user inputs at a control panel for processing of the feedstuffs beyond the buffer bin.

4. A system as claimed in any preceding claim, wherein there is a live bin mounted between the weighing platform and the feeder for the grinder,

the live bin having means for preliminary mixing of the raw materials.

5. A system as claimed in claim 4, wherein there is a pair of live bins mounted in parallel.

6. A system as claimed in claim 5, wherein there is a pair of grinders mounted in parallel.

7. A system as claimed in any preceding claim, wherein there is a magnetic metal detector mounted at the inlet of the grinder.

8. A system as claimed in any preceding claim, wherein the primary sieve comprises a brushing arrangement in which brushes are mounted centrally on a rotating shaft in the housing.

9. A system as claimed in any preceding claim, wherein the cuber line has an initial loading bin for reception of feedstuff from the buffer bin.

10. A system as claimed in claim 9, wherein there is an auger feeder mounted between the loading bin and the conditioner.

11. A system as claimed in any preceding claim, wherein steam is injected into the conditioner of the cuber line at a pressure in the range of 3.5 to 4.5 bar.

12. A system as claimed in any preceding claim, wherein the conditioner of the cuber line comprises means for input of molasses to the feedstuff.

13. A system as claimed in any preceding claim comprising means for injecting steam at a pressure in the range of 6.5 to 7.5 bar into the expander of the cuber line.

14. A system as claimed in any preceding claim, wherein means are provided for maintaining a pressure of 2 to 4 bar in the cone of the expander.

15. A system substantially as hereinbefore described with reference to and as illustrated to in the accompanying drawings.

16. Animal feedstuff whenever produced by a system as claimed in any preceding claim.

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ABSTRACT

"Animal Feedstuff Production"

(Fig. 1)

A production system is disclosed for production of animal feedstuffs. There is a raw material bin (5) associated with each raw material and a controller sequentially controls delivery of each raw material onto a weighing platform (7) until the total composition and weight for a single 2-tonne batch unit has been delivered. Production is controlled in batch units although an overall batch run may comprises 20 to 30 tonnes in total. After grinding and mixing, a buffer bin (19) holds a batch unit and interactive control may be used for controlling delivery of a batch unit to subsequent production stages. A meal molasses mixer (20) provides a final stage for meal which may then be directly packed. There are three cuber lines, one of which has an expander (39) and an enzyme-addition station (47). The cuber lines are connected in such a way that there is a large amount of versatility because a wide range of different feedstuffs may be produced by the one overall production system.

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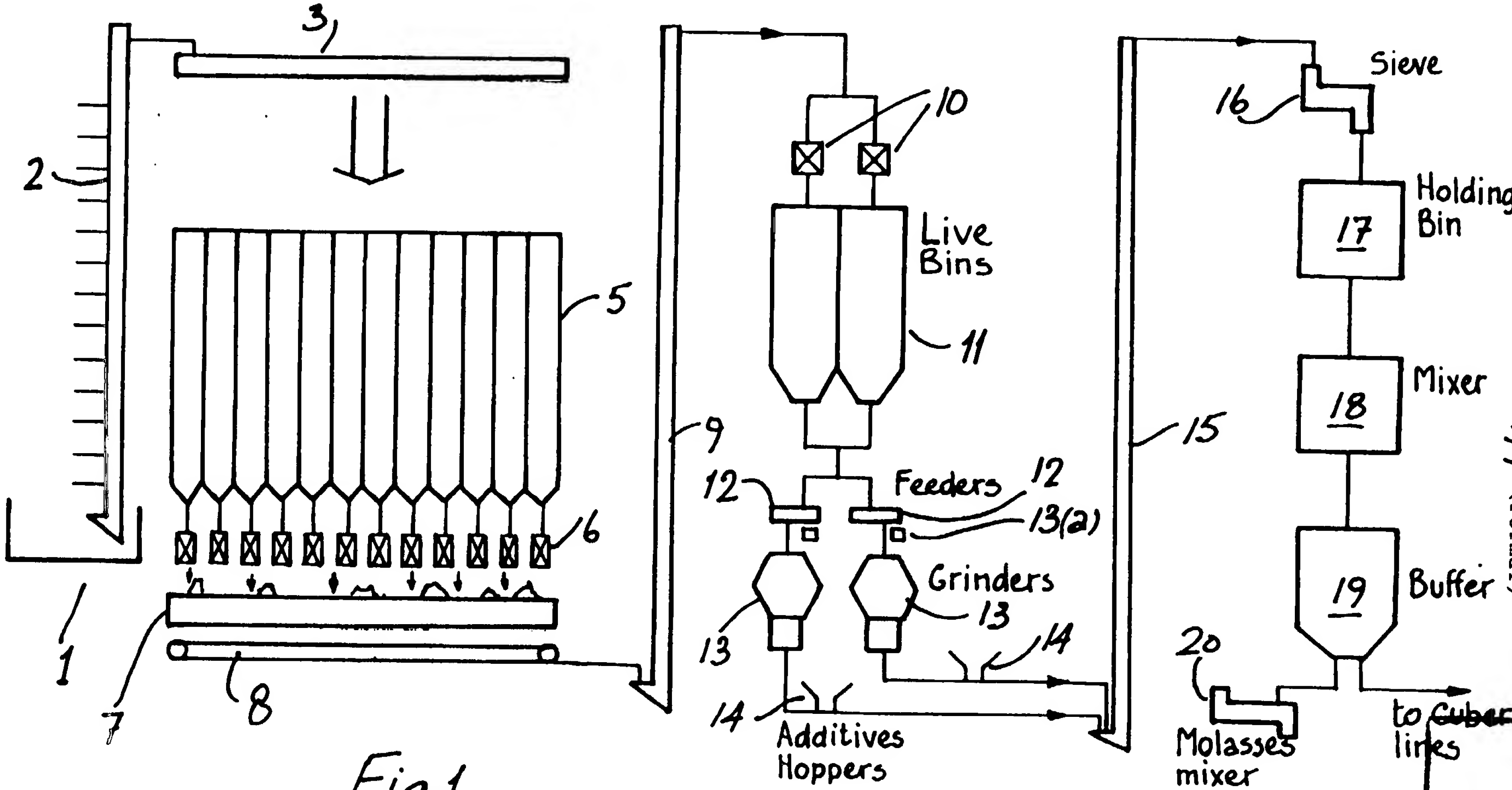

Fig.1

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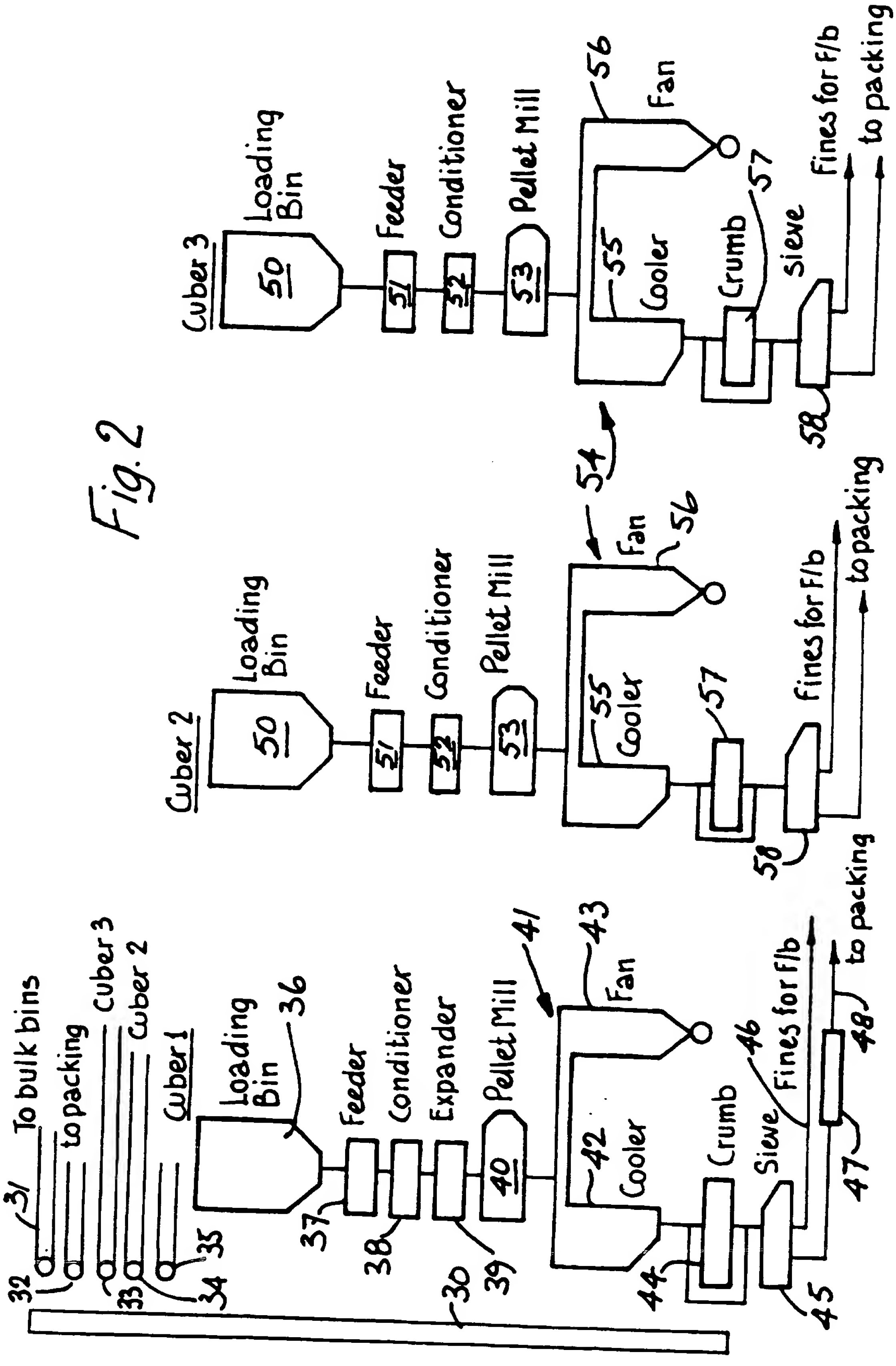
Cuber 1
Cuber 2
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Feeder
Conditioner
Expander
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Cooler
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Crumb
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Fig. 2

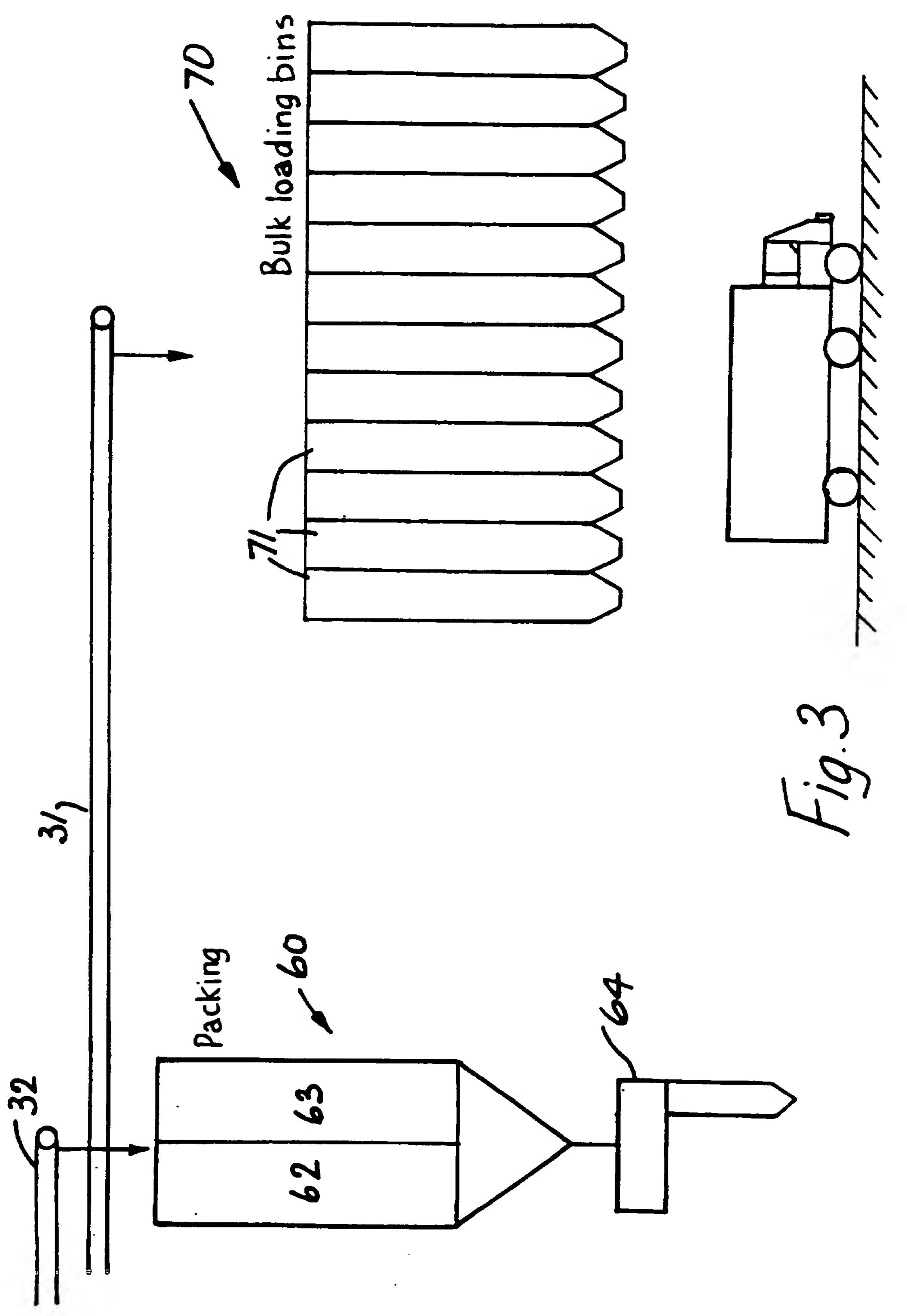

Fig. 3

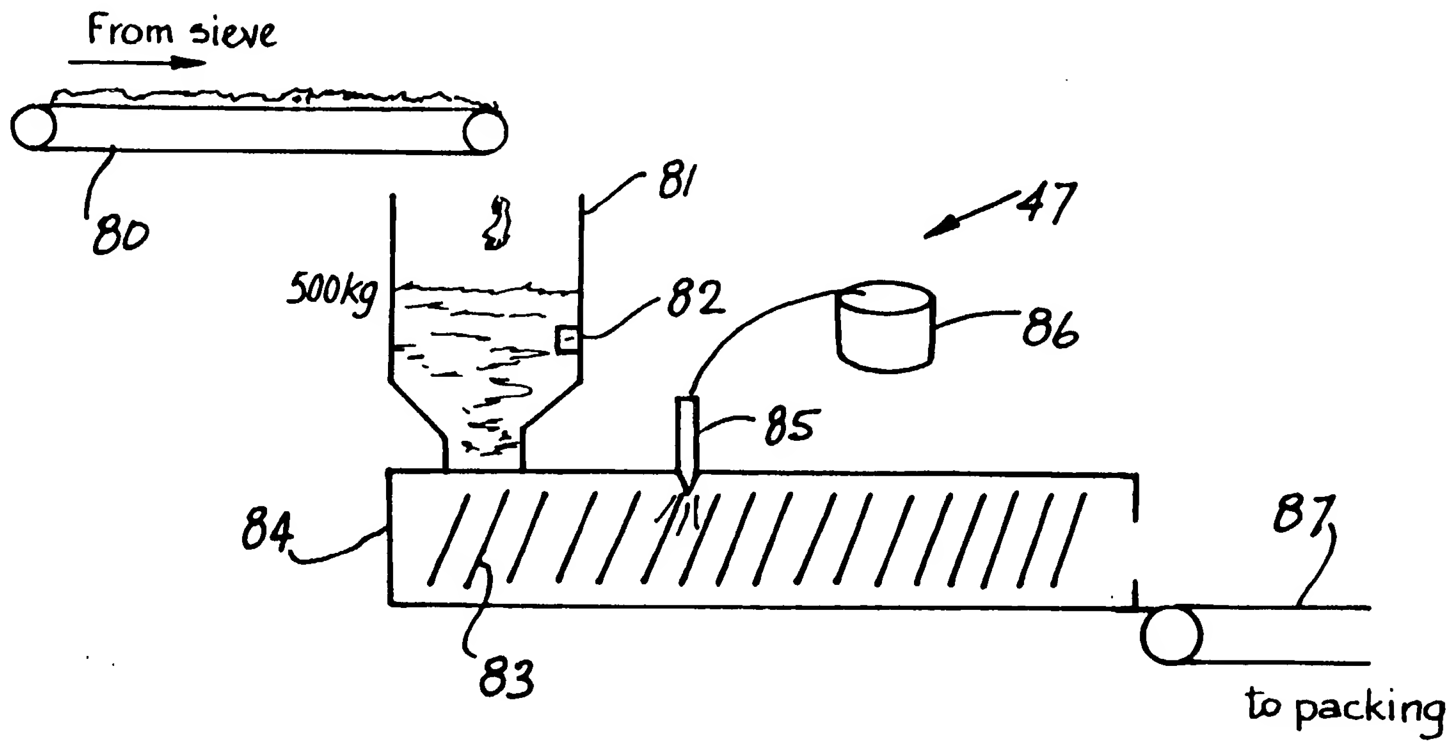

Fig.4

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